

## **CHAPTER 1**

### **OVERVIEW AND ISLAND ISSUES**

It has become increasingly clear that surface and groundwater in Hawaii, as well as the rest of the nation, has serious quality problems. It has been nearly thirty years since the Federal Water Pollution Control Act (commonly called the Clean Water Act) was first authorized to start addressing the water quality problems of the Nation. The early focus of the Clean Water Act was to control or reduce “point source” discharges. Point sources are typically end-of-pipe discharges from factories or sewage treatment plants. Hawaii has had its share of point source problems such as sewage treatment plants discharging close to nearshore waters and areas with poor circulation. With increased management and monitoring of point source discharges, water quality did improve locally as well as nationally.

Although there has been noted improvement and some waterbodies may be considered excellent in quality, overall water quality can be described in a range of slightly impaired to severely impaired. The reason these waters remain impaired is due to nonpoint source pollution, also known as polluted runoff. Nationally, nonpoint source pollution (NPS) has been recognized as the greatest remaining water quality issue. Hawaii also recognizes that NPS is the greatest threat to water quality in our islands. This recognition comes not only from water quality officials and local scientists but also from the public. The Hawaii Environmental Risk Ranking Project (1994) identified nonpoint source pollution and its impact on stream and coastal water quality as the issue of most concern to communities. Presently there are eighteen waterbodies identified statewide that consistently do not meet state water quality standards due to nonpoint source pollution.

#### **1.1 What is Nonpoint Source Pollution?**

Nonpoint source pollution, commonly called polluted runoff, occurs when rainwater moves on the surface or through the ground carrying the pollutants that have been left there by a myriad of sources. This polluted runoff flows to drainage systems and ends up impairing our streams and nearshore coastal waters. It is often difficult to trace polluted runoff to its point of origin since it comes from many different land uses such as urban industrial and residential zones, agricultural lands, marinas, and forests. Significant pollutant types include sediments, nutrients, toxins, floatables, and pathogens. In the simplest terms, nonpoint source pollution is any pollution that is not from a point source.

The consequences of nonpoint source pollution are well known: increased risk of disease from water recreation, algae blooms, fish kills, destroyed aquatic habitats, and turbid waters. Some polluted runoff is from natural sources. Most, however, results from people’s activities on the land and water. Since nonpoint source pollution results from how we choose to use our land and the activities we conduct, we all hold the key to its prevention.

The importance of coastal water quality to the State of Hawaii cannot be overstated. Tourism is Hawaii’s most important industry. Nearly six million visitors visit our state each year. Hawaii’s unique marine and terrestrial environment is among the main reasons it is chosen as a visitor destination. Clean streams and coastal water are an integral component of that desired environment. Water quality is vital to Native Hawaiian cultural practices; leisure and

recreation –swimming, boating, snorkeling, SCUBA diving, paddling and surfing; fishing and other food gathering activities; and research and technology. The State has an economic goal of diversified, high technology development. Major research on innovative ocean power sources, transoceanic fiber optic communications, and marine life is carried out in Hawaii. For instance, designation of a national sanctuary for humpback whales in the Hawaiian Islands occurred in part on the potential for research in these waters. Clean ocean and coastal water is the key to having these industries or research opportunities continue here.

Hawaii is considered the "endangered species capital of the world." Hawaii has a phenomenal number of flora and fauna that are at risk of becoming extinct. There are several reasons for this, one being the degradation of watersheds and associated streams and coastal waters. For example, elevated sediment or nutrient levels can off-set the balance in a riparian system to the point that introduced fish species are able to prosper while native ones cannot compete, lose habitat, and therefore decrease in numbers. Non-native plants and animals have their impact on water quality too. Many non-native plants have successfully replaced native vegetation, and in some situations, they fail to hold soil adequately.

### **1.2 Hawaii's Unique Geography**

The Hawaiian Archipelago is located in the central Pacific Ocean, approximately 3,000 miles from the continental United States. The State of Hawaii consists of eight major and 124 minor islands in the 1,523-mile archipelago. The eight major islands include the islands of Hawaii, Oahu, Maui, Kauai, Molokai, Lanai, Niihau, and Kahoolawe.

The State Capital is Honolulu on the island of Oahu, which is 1,367 miles from Kure Atoll (the westernmost end of the State), 2,397 miles from San Francisco, and 4,828 miles from Washington, D. C. The highest peak in the State is Mauna Kea on the island of Hawaii, 13,796 feet above sea level; the longest stream is Kaukonahua Stream on the island of Oahu, which is 33 miles in length.

Over the span of 25 million years, volcanic shield building followed by erosion, subsidence, and formation of coral reefs formed the islands of the archipelago. This volcanic activity is still occurring on the island of Hawaii. Consequently, the topography, geology, and climate in Hawaii are characterized by remarkable variations, which include unique and diverse microenvironments side-by-side. Within 30 miles on the island of Hawaii, the ecosystem changes from coastal marine coral reefs to the snow-capped summit of Mauna Kea. The highest lake in the nation, Lake Waiau, is located at an elevation of 13,020 feet on Mauna Kea. The extremes of altitude and moisture provide a variety of habitats for many unique plant and animal species. The Alakai Swamp on the island of Kauai receives over 400 inches of rain per year. Mt. Waialeale (elevation 5,148 feet) rising above Alakai Swamp is the world's wettest spot, averaging 444 inches of rainfall annually. Almost every major Hawaiian Island has a pali, steep mountain cliffs, which exceeds 3,000 feet in elevation. These mountains are high enough to cause moisture laden trade winds to rise, condense into clouds, and provide vital rainfall. Rainfall regimes for each island are steep, usually culminating in 200 inches of annual rainfall at

the mountaintops. Hawaii's rainfall regime is unique to the rest of the nation. This rainfall has a lot of erosive potential and is one reason why it is often difficult to retain runoff. Hawaii is subject to very arid conditions as well. The lower Kawaihae watershed on Hawaii Island gets only 9 inches of rainfall per year.

Hawaii's watersheds are unique when compared to the contiguous United States. Hawaii has no extensive river basin system comparable, for example, to the Missouri River Basin. Each of the major islands is a discrete hydrologic system of streams and related drainage areas. Each hydrographic area consists of a large number of small watersheds ranging in size from one or two square miles up to 80 square miles. Most river or stream courses are just a few miles long and are subject to flashy flows. Hawaii's watersheds are steep, with highly permeable volcanic rocks and soils. Many of Hawaii's soils are considered highly erodible. Many of these watersheds are amphitheater shaped, with steep walls ranging from 40-70 degree slopes.

The State of Hawaii has one of the highest percentages of endemic plants and animals on earth and of endangered species in the United States. On the other hand, the rugged topography of the islands has also restricted most human activity and impacts to coastal and lowland areas. Consequently, most of the water quality monitoring activities conducted by the State are restricted to the lowland areas. It is assumed, but unproven, that most upland areas of the State, such as the Alakai Swamp, and many miles of coastline, such as the north coast of East Molokai, are in pristine condition.

The majority of the watersheds and streams are small, with few tributaries that drain a limited number of valley areas. Streams generally run directly from the mountains to the coastlines, so that stretches of coastline have several small streams rather than one or two large rivers draining the inland areas.

While each stream is uniquely affected by the uses of the lands through which it passes, there is a similarity in the cause of their impairments: nonpoint source pollution. The bases for this assessment are stream usage, the lack of point source discharges, knowledge of land use, and an understanding of the ecosystem. Few streams are monitored routinely.

In general, habitat destruction, introduction of alien species, intensive fishing, and surface runoff containing high concentrations of sediments, bacteria, nutrients and other chemicals have, over time, caused alterations in the aquatic community structure and a publicly perceived decrease in the aesthetic qualities of surface waters.

### **1.3 Surface Water Assessment**

In the preparation of the Department of Health's Section 305(b) Report, State waters are assessed and likely contributors to impacts are provided. The majority of the information used in the Section 305(b) Report is gathered from the Clean Water Branch of the Department. Other sources contributing information include the Department's Environmental Planning Office and the Epidemiology Branch, and the Department of Land and Natural Resources (See Tables 1-1 and 1-2).

Based on the Department of Health Administrative Rules, Chapter 11-54 HAR, "Water Quality Standards" (adopted April 17, 2000), all waters in Hawaii serve the following two purposes: fish/wildlife habitat and human-related recreational activities, consistent with the "fishable" and "swimmable" goals established in the Clean Water Act.

All state waters, except those on the island of Kahoolawe, are classified as fishable and swimmable because their water quality can support wildlife and aquatic recreational activities.

The inland waters of the 45 square mile island of Kahoolawe are the only unclassified waters in the State of Hawaii. These inland waters are mainly intermittent streams. This island had been used by the United States Navy as a target range.

<p>Table 1-1 Summary of Fully Supporting, Threatened, and Impaired Waters: Rivers and Streams (Reported in miles)<sup>a</sup></p>			
DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE
	EVALUATED	MONITORED	
SIZE FULLY SUPPORTING ALL ASSESSED USES	1194.16	6.45	1200.61
SIZE FULLY SUPPORTING ALL ASSESSED USES, BUT THREATENED <sup>b</sup> FOR AT LEAST ONE USE	0.00	0.00	0.00
SIZE IMPAIRED <sup>c</sup> FOR ONE OR MORE USES	2604.29	99.77	2704.06
SIZE NOT ATTAINABLE FOR ANY USE AND NOT INCLUDED IN THE LINE ITEMS ABOVE	0.00	0.00	0.00
TOTAL ASSESSED	3798.45	106.22	3904.67

<sup>a</sup> 1998 State 305(b) Report.

<sup>b</sup> Size threatened is a distinct category of waters and is NOT a subset of the size fully supporting uses. It is added into the totals in the bottom line.

<sup>c</sup> Impaired means partially or not supporting a designated use.

**Table 1-2**  
**Individual Use Support Summary: Rivers and Streams (Reported in Miles)<sup>a</sup>**

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING	SIZE SUPPORTING BUT THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING	SIZE NOT ATTAINABLE	SIZE NOT ASSESSED
	OVERALL	3865.47	1289.50	0.00	657.92	1918.05	0.00	0.00
PROTECT & ENHANCE ECOSYSTEM	AQUATIC LIFE	3904.55	1565.91	0.00	0.00	2338.64	0.00	0.00
PROTECT & ENHANCE PUBLIC HEALTH	FISH CONSUMPTION	3891.85	3878.41	0.00	0.00	13.44	0.00	0.00
	SHELLFISHING	3904.55	3903.95	0.00	0.00	0.60	0.00	0.00
	SWIMMING	3897.81	3897.21	0.00	0.00	0.60	0.00	0.00
	SECONDARY CONTACT	3904.55	3903.95	0.00	0.00	0.60	0.00	0.00
	DRINKING WATER	3889.23	3888.63	0.00	0.00	0.60	0.00	0.00
SOCIAL & ECONOMIC	NON-DEGREDAATION	3904.67	1610.75	0.00	69.44	2224.48	0.00	0.00
	AESTHETICS	3880.77	3857.04	0.00	0.00	23.73	0.00	0.00
	AGRICULTURE	3904.55	3903.95	0.00	0.00	0.60	0.00	0.00
	CULTURAL OR CEREMONIAL	3904.55	3903.95	0.00	0.00	0.60	0.00	0.00

<sup>a</sup> 1998 State 305(b) Report.

0 Category applicable, size of waters is zero.

### 1.4 Estuary and Coastal Assessment

As defined in HAR, Chapter 11-54 (October 1992), estuaries refer to deep, characteristically brackish coastal waters in well-defined basins with a continuous or seasonal surface connection to the ocean that allows entry of marine fauna. Most estuaries in Hawaii are within embayments that generally are not subject to rapid and efficient flushing. Accumulation of silt and organic materials may occur as a result of urban and agricultural runoff. Most of these estuaries support beneficial uses but are impacted by pollutants from land-based sources (i.e. runoff) and may thus appear "not swimmable." However, since the risk of illness is proportional to the amount of Enterococcus bacteria from sewage, not runoff, the estuaries may remain "swimmable" despite the exceedance of the seven CFU/ 100 ml. Standard (See Tables 1-3 and 1-4).

Table 1-3 Summary of Fully Supporting, Threatened, and Impaired Waters: Estuaries (Reported in Square Miles) <sup>a</sup>			
DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE
	EVALUATED	MONITORED	
SIZE FULLY SUPPORTING	0.04	23.71	23.75
SIZE FULLY SUPPORTING ALL ASSESSED USES, BUT THREATENED <sup>b</sup> FOR AT LEAST ONE USE	0.00	0.42	0.42
SIZE IMPAIRED <sup>c</sup> FOR ONE OR MORE USES	0.90	29.69	30.59
SIZE NOT ATTAINABLE FOR ANY USE AND NOT INCLUDED IN THE LINE ITEMS ABOVE	0.00	0.00	0.00
TOTAL ASSESSED	0.94	53.82	54.76

<sup>a</sup> 1998 State 305(b) Report.

<sup>b</sup> Size threatened is a distinct category of waters and is NOT a subset of the size fully supporting uses. It is added into the totals in the bottom line.

<sup>c</sup> Impaired means partially or not supporting a designated use.

Table 1-4: Summary of Fully Supporting, Threatened, and Impaired Waters: Coastal Shoreline (Reported in Miles) <sup>a</sup>			
DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE
	EVALUATED	MONITORED	
SIZE FULLY SUPPORTING ALL ASSESSED USES	644.99	137.08	782.07
SIZE FULLY SUPPORTING ALL ASSESSED USES, BUT THREATENED <sup>b</sup> FOR AT LEAST ONE USE	6.20	4.25	10.45
SIZE IMPAIRED <sup>c</sup> FOR ONE OR MORE USES	6.50	84.82	91.32
SIZE NOT ATTAINABLE FOR ANY USE AND NOT INCLUDED IN THE LINE ITEMS ABOVE	0.00	0.50	0.50
TOTAL ASSESSED	657.69	226.65	884.34

<sup>a</sup> 1998 State 305(b) Report.

<sup>b</sup> Size threatened is a distinct category of waters and is NOT a subset of the size fully supporting uses. It is added into the totals in the bottom line.

<sup>c</sup> Impaired means partially or not supporting a designated use.

## 1.5 Water Quality Limited Segments

Impaired waterbodies of the State are designated in several plans: State 303(d) List, State 305(b) Report, and Clean Water Act Section 208 Water Quality Management Plans (WQMP) for all four counties.

Each coastal water segment is linked with an associated land area. Each island is divided into hydrographic areas based on surface topography. Subareas are defined by the related drainage area, stream system, geography, and coastal water segment. A coastal water quality limited segment coincides with those coastal waters that receive discharges from point and nonpoint sources located within that defined area.

Water Quality Limited Segments are defined in Section 303 of the Clean Water Act and EPA regulations as water areas where existing water quality does not meet, and will not meet, applicable water quality standards even after effluent limitation requirements on point source discharges are applied.

The segments have been designated by the Department of Health based on common hydrological characteristics, existing water quality, and water quality standards. Population distribution, sewer districts, and water distribution were also used to determine segment boundaries. Segment designation as a Water Quality Limited Segment reflects the amount of flow, type and quantity of pollutants, the degree of violation of water quality standards, and the interactive and dispersive capacity of the receiving waters. In addition, consideration is given to public health hazards, the actual uses of the receiving waters, the impediments to controlling pollutant discharges, and compliance with water quality limited and effluent limitation requirements, based on the best available data and information. *In every instance, the reason a segment is designated as a Water Quality Limited Segment is due to the high pollution emissions discharged by nonpoint sources.*

Section 319 was added to the Clean Water Act in 1987 specifically to address nonpoint sources of pollution. It requires each state to identify navigable waters which, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain state water quality standards. Since nonpoint source pollution is the reason for designation of specific waterbodies as Water Quality Limited Segments, all waterbodies in Hawaii to be identified under the Section 319 requirement are Water Quality Limited Segments.

The Water Quality Limited Segments identified by Department of Health in 1973 to meet the requirements of Section 303(d) of the Clean Water Act were later incorporated into State of Hawaii reports required by Section 305(b) of the Clean Water Act. These biennial 305(b) reports are the mechanism by which states report on the status of their water quality. The report describes the nature and extent of state water pollution and, along with other requirements, identifies Water Quality Limited Segments. Hawaii's most recent 305(b) report (1998) identifies 18 Water Quality Limited Segments in the State (see Table 1-5 and Figure 1-1).

The 18 segments were selected by Department of Health from areas where the State had sufficient information to make judgments about water quality. Two levels of assessments were used: segment identification based on ambient water quality monitoring, and segment identification based on other information. Areas not identified as Water Quality Limited Segments are identified as Effluent Limited Segments and are assumed to meet or will likely meet applicable water quality standards after point source discharge controls are applied. This list is reviewed every two years as required by Section 303(d), Clean Water Act. In January 1996, the Department of Health began soliciting nominations from the public for impaired waterbodies, and conducting an assessment on each nominated waterbody. The list of priority watersheds in Table 1-5 reflects the list of Water Quality Limited segments finalized in 1997.



Table 1-5 Hawaii's Priority Watersheds based on Water Quality Limited Segments		
WATERSHED & ISLAND	COUNTY	SPECIFIC POLLUTANTS
Hilo Bay, Hawaii	Hawaii	Turbidity
Ala Wai Canal, Oahu	Honolulu	Pesticides, metals, lead, nutrients, nitrogen, phosphorous, siltation, pathogens, turbidity
Honolulu Harbor, Oahu	Honolulu	Nutrients, siltation, turbidity
Kahana Bay, Oahu	Honolulu	Siltation, suspended solids
Kaiaka-Waialua Bays, Oahu	Honolulu	Turbidity
Keehi Lagoon, Oahu	Honolulu	Siltation, suspended solids, turbidity
Kewalo Basin, Oahu	Honolulu	Nitrogen
Koolaupoko, Oahu: -Kaneohe Bay -Kapaa Stream -Kawa Stream -Waimanalo Stream	Honolulu	-siltation -nutrients, siltation, pathogens -nutrients, siltation, pathogens, turbidity, exotic species -nutrients, siltation, other habitat alterations, pathogens, exotic species
Pearl Harbor, Oahu	Honolulu	Nutrients, siltation, turbidity, organic chemicals
Hanapepe Bay, Kauai	Kauai	Nutrients
Nawiliwili Bay, Kauai	Kauai	Turbidity, metals
Waimea Bay, Kauai	Kauai	Nutrients
Kahului Bay, Maui	Maui	Nutrients, pathogens
South Molokai, Molokai	Maui	Nutrients, suspended solids, turbidity
West Maui, Maui	Maui	Nutrients, suspended solids, turbidity, pathogens

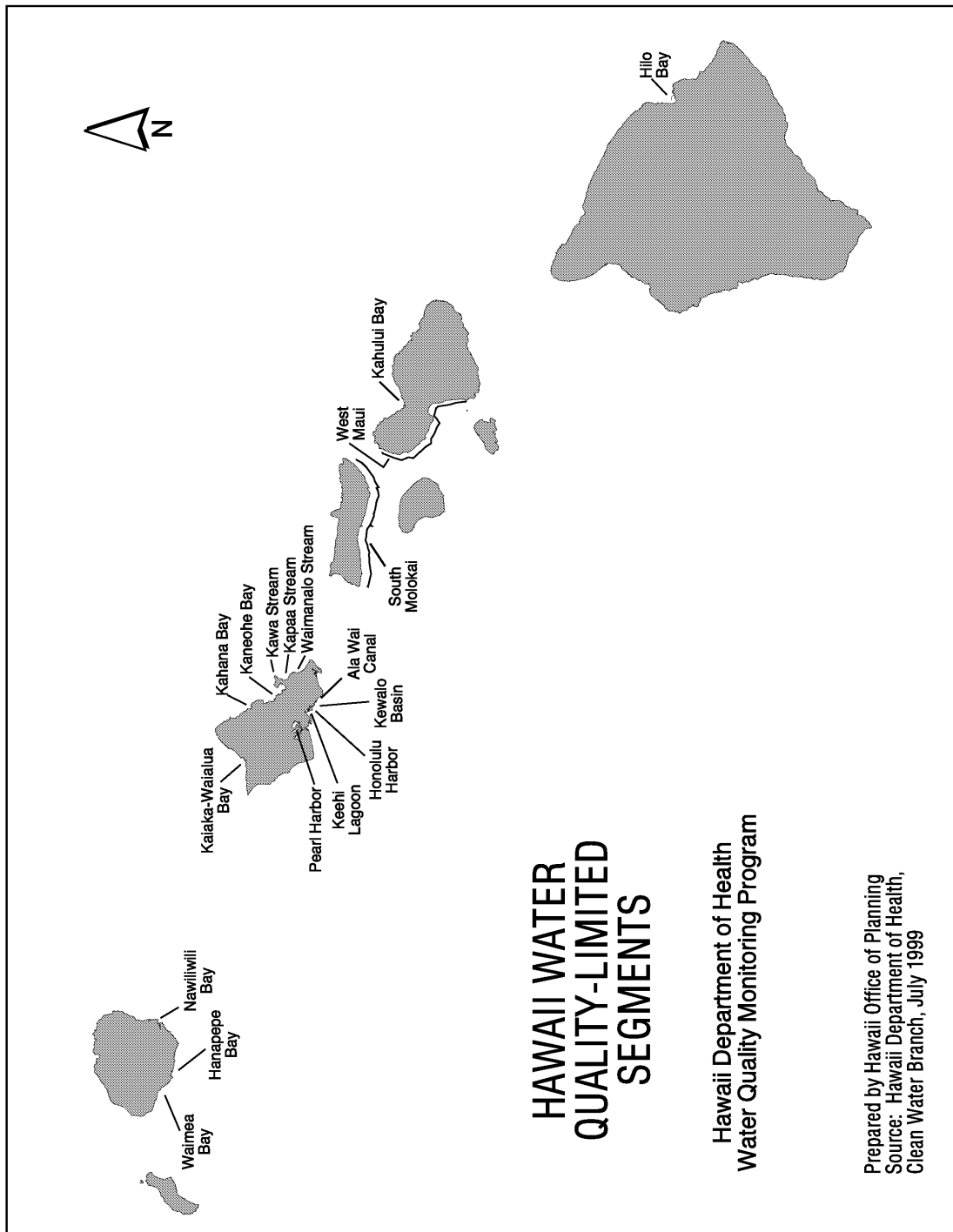


Figure 1-1: Hawaii's Water Quality Limited Segments

## **1.6 Island-by-island Overview of Water Quality Limited Segments and Their Health**

### *1.6.1 City and County of Honolulu (Oahu)*

The following descriptions of the Water Quality Limited Segments on Oahu are based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii's Coastal Nonpoint Pollution Control Program Management Plan* (1996), *Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems* (Department of Health 1990), and the *Water Quality Management Plan* for the City and County of Honolulu (C&C of Honolulu 1990). There are eleven Water Quality Limited Segments on Oahu. (See Appendix F for additional details.) Since polluted runoff is mostly due to human activity, it is understandable that the most populous island has the most Water Quality Limited Segments.

#### **1.6.1.1 Kahana Bay**

Kahana Bay is a drowned river valley, located on the northeast coast of Windward Oahu. The bay has a total area of 294 acres (DOH 1990a, p. V-7). The Kahana State Park, with an area of 7.96 square miles, covers almost the entire drainage area of 8.33 square miles.

Kahana Bay is a natural embayment, used for swimming, boating, and other water recreational sports. It is an example of a waterbody where natural events have a greater influence on water quality than human activities. The entire valley is a State Park. It is essentially a pristine area, with only limited development at the lower end of the valley (DOH 1990a, p. V-7).

There are no point source discharges into the bay. There are, however, some cesspools used by the estimated 130 people living in 30 households. The existing cesspools will be eliminated as homes are refurbished. Public convenience stations are located in the State Park and the City Beach Park and discharge wastes into cesspools. Sediments and nutrients are transported into the bay by Kahana Stream and overland routes (C&C of Honolulu 1990, p. 8-18).

Total freshwater runoff into the bay is estimated at 30 million gallons per day (mgd). Of the eight parameters tested by the Department of Health at its monitoring station, five parameters have values exceeding the maximum criteria allowed for that parameter. Major violations have been found for ammonia nitrogen, total nitrogen, total phosphorus, turbidity, and chlorophyll. The high levels of nitrogen and phosphorus are primarily due to the lush vegetative growth in the valley and the stream estuary.

#### **1.6.1.2 Kaneohe Bay**

Kaneohe Bay is the largest embayment in the State of Hawaii with a surface area of 18 square miles. Its watershed is 40 square miles and average stream flows are 64 mgd (C&C of Honolulu 1990, p. 8-19).

Historically, Kaneohe Bay teemed with marine life. Major problems arose as a result of the introduction of hoofed animals, and more significantly, because of the extensive farming of pineapple prior to 1940, which caused extensive sedimentation of the bay. Also the bay itself

was severely stressed by a massive coral reef dredging (about 11 million cubic yards) between 1939 and 1942 as part of seaplane landing area construction; the spoil was used for landfill in the bay, primarily at what is now known as Marine Corps Base Hawaii. The bay was again stressed by the construction of a sewage disposal outfall in the center of the south bay that introduced unnaturally large amounts of nutrients. Urbanization in the late 1950s through the 1970s brought uncontrolled grading which exacerbated the prior stresses of erosion and sedimentation.

In addition, it is now well documented that major inflows of freshwater from high intensity rainfall can build up in the bay, creating a lens which can reach up to 5 feet in depth floating on the surface of the bay. Runoff problems are compounded by channelization in the watershed, the paving over of formerly permeable surfaces in the basin, and the filling and loss of wetlands and fishponds along the shores, which acted in the past to detain stormwater runoff.

The bay has shown improvement in water quality over the past two decades, and today is somewhat stabilized. Elimination of all municipal effluent discharges into the bay has been accomplished. Most of the urban areas are served by municipal sewers, but the rural areas from Ahuimanu to Waikane are still being served by 270 household cesspools (C&C of Honolulu 1990, p. 8-21). There has been a dramatic decline in phosphorus and turbidity since 1979, when sewage discharge was diverted from the bay. The termination of sewage discharges and better management of construction activities has resulted in improved survival of some species of coral and other organisms.

However, urban runoff continues to be a major source of pollution to the bay. The water quality parameters frequently violated are turbidity and nitrogen during winter storms. The major sources affecting turbidity and suspended solids parameters are natural runoff, urban stormwater, and small farming. The same sources, as well as winter storms, affect the nitrogen parameters. Direct groundwater seepage into the bay is estimated to be 60 mgd and storm runoff, 40 mgd (C&C of Honolulu 1990, p. 8-19).

Estimates of sediment loading into Kaneohe Bay from storm runoff range from 33,000 to 131,000 tons per year. The entire bay is affected by suspended particles, especially in the southern section of the bay where the residence time has been estimated to be almost 24 days (C&C of Honolulu 1990, p. 8-22).

### 1.6.1.3 Ala Wai Canal

The Ala Wai Canal is a manmade canal completed in 1929 to reclaim marshlands fed by the perennial Manoa and Palolo streams and to control mosquitoes. The marsh, located in what is now the McCully-Kapiolani District and adjacent to Waikiki, consisted of taro patches, rice paddies, and duck and fish ponds. The Ala Wai Boat Harbor is located at the mouth of the canal (C&C of Honolulu 1990, p. 8-22).

The water quality limited segment includes the 9,770-foot long canal, the 126-acre boat harbor, and the boat channel to the 30-foot depth contour. The harbor is recognized as an embayment. A portion of the canal is an estuary.

Major contributions to water quality problems come from: erosion in the forest reserve areas at the upper end of Manoa Valley; groundwater inflow; storm runoff from residential and commercial developments; direct runoff from Ala Wai Field, Park, and Golf Course; dumping of household and yard wastes into the Manoa and Palolo streams; and two minor point source discharges – washwater from the Ala Wai Marine Railway dry dock operation (only under emergency conditions), and 1.60 mgd discharge of warm water from the air conditioning system of the Yacht Harbor Condominium. The entire drainage area is served by municipal sewers except for the Crater Road area of West Kaimuki and Makiki-Puowaina. These non-sewered areas have household cesspools and serve an estimated population of 1,300 people (C&C of Honolulu 1990, p. 8-24).

The average flow into the Ala Wai Canal from its tributary streams is estimated to be between 20-30 mgd. It also receives storm runoff from Manoa, Palolo, Makiki, Waikiki, and other areas. Sediments are deposited in the Canal because the low flow velocity in the canal is less than the settling velocity of the sediment. It is believed that large quantities of sediment are generated in the watershed areas by natural erosion processes. The canal was dredged by the City in 1966 and again by the State in the late 1970s. From the results of present and past studies of sediments in the canal, it is estimated that the rate of siltation has been relatively consistent at 9,000 to 11,000 cubic yards per year (Edward K. Noda & Associates 1992b, p. 4). Without the canal, much of this sediment would be released into coastal waters.

#### 1.6.1.4 Kewalo Basin

Kewalo Basin is a manmade harbor, approximately 78 acres in area. Constructed by the U.S. Navy in 1945, it is homeport for the local tuna fleet, chartered sport fishing boats, and excursion craft serving the tourist industry. The basin is surrounded by shopping centers, a major highway, and the light industrial areas, commercial shops, and restaurants of Kakaako and Kewalo, as well as park space at Kakaako and Ala Moana. Kewalo Basin is classified as an embayment. The water limited quality segment encompasses the entire basin and channel out to the 30-foot depth contour (C&C of Honolulu 1990, pp. 8-25).

Low levels of dissolved oxygen and unsatisfactory pH levels have been measured at the outlet of the Ala Moana Park drains to the northeast sector of the basin. It is suspected that allowable limits for the nitrogen, phosphorus, and turbidity parameters are exceeded during periods of heavy storm runoff. Circulation of water in Kewalo Basin is hindered by its design. Consequently, the urban pollutants that collect in the basin remain concentrated for extended periods (DOH 1990a, pp. V-11 and V-12).

The primary sources of pollutants entering Kewalo Basin are the seven drains collecting urban runoff from commercial, industrial, and residential sectors of Honolulu, which bring street debris, oil, chemicals, nutrients, and heavy metals into the Basin. There are no discharges of any sediment from streams since the drainage area is entirely urbanized (C&C of Honolulu 1990, p. 8-27).

#### 1.6.1.5 Keehi Lagoon

Keehi Lagoon's 1,116 acres make it the largest lagoon in the State. It is located in a heavily industrialized area between Kapalama-Sand Island and Honolulu International Airport. The Mapunapuna and Shafter Flats industrial parks and the Middle Street interchange of H-1 are located to the north. Keehi Boat Harbor and Keehi Marine Drydock are located along the Kapalama shoreline and serve boating and sailing interests. Kalihi Stream from the northeast and Moanalua Stream from the northwest meet at the head of the lagoon at Keehi Lagoon Beach Park. Keehi Lagoon is classified as an embayment; Keehi Harbor and Keehi Drydock Boat Harbor are classified as shallow draft recreational harbors. The water quality segment encompasses the entire lagoon to the 30-foot depth contour (C&C of Honolulu 1990, p. 8-27).

The lagoon is used intensively for bait fishing, crabbing, paddling, and other water contact sports. Boating activities are especially heavy during weekends and holidays. A boat washing facility is part of the boat harbor (C&C of Honolulu 1990, p. 8-27). Although circulation in Keehi Lagoon is good, it regularly experiences violations of water quality parameters for phosphorus and turbidity. Currents may transport polluted waters from Honolulu Harbor into the lagoon and recirculate suspended matter within it. Other pollutants come from the streams and industrial areas (C&C of Honolulu 1990, pp. 8-27 and 8-28).

The elimination of the municipal and U.S. Army raw sewage discharges in nearshore waters off Sand Island and the airport outfall off Ahua Point have greatly improved water quality in the lagoon. The number of cesspools receiving commercial and industrial wastes in the Mapunapuna and Kapalama areas is not known, but it could be as many as 150.

In residential areas, trash, plant cuttings and yard debris are frequently dumped in the stream channels and reach the lagoon. Policing of illegal dumping is difficult because it can occur at any time (C&C of Honolulu 1990, p. 8-30).

#### 1.6.1.6 Honolulu Harbor

Honolulu Harbor is the largest commercial deep-draft harbor in the State. The harbor, with a water surface area of 537 acres, is protected from the open ocean by coral reefs and Sand Island, a 500-acre manmade island. Goods and freight processed at the harbor cover the entire spectrum, from pineapple and cattle to automobiles and petroleum products. The harbor handles over 11 million tons of cargo annually (C&C of Honolulu 1990, p. 8-30).

Honolulu Harbor is classified as an embayment. The water quality limited segment encompasses the entire harbor from Keehi Lagoon to the Fort Armstrong main channel entrance to the 30-foot depth contour. Both Nuuanu (draining 8.4 square miles) and Kapalama Stream (draining 1.6 square miles) bring runoff from industrial, commercial, and residential developments into the harbor (C&C of Honolulu 1990, p. 8-31).

The most frequently violated parameters are total nitrogen, total phosphorus, turbidity, dissolved oxygen, and pH. Before about 1972, pineapple canneries and an industrial gas

company discharged a biochemical oxygen demand (BOD) load equivalent to a raw sewage discharge from 150,000 people. More recently, Kapalama Canal's wasteload has been limited to the discharge of thermal water.

Studies of the harbor indicate that nitrogen, phosphorus, and turbidity levels in the water regularly exceed State water quality standards. Significant levels of copper, zinc, chromium, nickel, lead, chlordane, and dieldrin have been identified in Department of Health sampling. Storm drain outlets discharge into the harbor throughout its the periphery (C&C of Honolulu 1990, p. 8-31).

No sediment data from the streams are available, but the U.S. Army Corps of Engineers (USACOE) estimated that 50,000 cubic yards of sediments are discharged in the harbor each year from all sources. According to USACOE, the sediments are composed of high percentages of land-derived silty clays and a small percentage of sand. The harbor is dredged at about five year intervals (C&C of Honolulu 1990, p. 8-32).

#### 1.6.1.7 Pearl Harbor

Pearl Harbor is the State's largest estuary and is almost completely surrounded by federal military installations. The U.S. Navy installation with its associated shipyard, maintenance supply center, public works center, and ammunition depot is located around the harbor. Headquarters for the 14th Naval District are also sited at the harbor. The harbor consists of East Loch, Middle Loch, West Loch, Southeast Loch, and Ford Island and has a water surface area of about 8 square miles. More than 12 miles of docks and 4 dry-docks are available for ship repairs. The US Air Force's Hickam Air Force Base borders a small portion of Pearl Harbor's eastern shoreline.

The Water Quality Limited Segment includes the entire harbor, the mouths of perennial streams discharging into the harbor, and extends to the 30-foot depth contour from the Reef Runway to Oneula Beach (C&C of Honolulu 1990, p. 8-32).

Because of its geologic origin, Pearl Harbor has been the "sink" of the southern coastal plain of Oahu. Five streams – Halawa, Aiea, Kalauao, Waimalu, and Pearl City – are tributary to East Loch. Waiawa enters Middle Loch, and Waikele and Honouliuli drain into West Loch. The area draining into the lochs totals 111 square miles (C&C of Honolulu 1990, p. 8-32).

Beneficial uses identified for Pearl Harbor include bait fish and shellfish propagation in West and East Lochs, shipping, navigation, industrial water in East Loch, and water fowl habitat in Middle and West Lochs.

There are five point source discharges operated by the U.S. Navy within the harbor, one (Fort Kamehameha STP) discharging at the main ship channel, and a nonmilitary point source, Waiiau Power Plant, which discharges thermal water. Most of the urban areas around the harbor are served by municipal sewers; an estimated number of 400 households are on cesspools (C&C of Honolulu 1990, p. 8-36).

Water quality parameters that are frequently violated in Pearl Harbor include nitrogen, phosphorus, turbidity, fecal coliform, temperature, and chlorophyll a.

#### 1.6.1.8 Kaiaka-Waialua Bay

This Water Quality Limited Segment includes two adjacent waterbodies on the North of Oahu. Kaiaka Bay is classified as an embayment, while the much broader Waialua Bay is classified as marine waters. Haleiwa Boat Harbor, located at the original mouth of Anahulu River, is also an embayment within the Water Quality Limited Segment's boundary.

Both bays receive drainage from major streams. Kiikii Stream (with tributaries Poamoho and Kaukonahua streams) and Paukauila Stream (which includes Helemano and Opaepa streams) flows into Kaiaka Bay. The area of the drainage basin is 79.8 square miles (C&C of Honolulu 1990, p. 8-39). Leakage of fresh water through caprock into Opaepa, Helemano, Poamoho, and Kaukonahua streams and the bay is estimated to be 7.05 mgd. Peak storm flows (100 year storm) estimated for Kiikii Stream are 39,000 cubic feet per second (cfs); and for Paukauila Stream, 18,700 cfs. As much as 70% of the streams are diverted for agriculture.

Anahulu River and its tributaries (Kawaiiki and Kawainui streams) discharge into Waialua Bay. At Waialua Bay, Anahulu River has a drainage area of 16.0 square miles and a 100-year peak discharge of 16,200 cfs.

Data collected at the Department of Health monitoring station indicate that the maximum allowable levels of most parameters are exceeded except for dissolved oxygen. Most noteworthy are total phosphorus, nitrate and nitrite nitrogen, chlorophyll a, and turbidity. The major sources of pollutants discharging into the embayments are sediments from the drainage basins, household cesspools, injection wells from treatment plants, and a point source discharge of thermal water. Thirteen private STPs and one municipal wastewater treatment plant (primary) in the Waialua and Haleiwa communities discharge effluent into seepage pits or injection wells. 2,312 household cesspools in the Waialua and Haleiwa area, serving a population of 7,232 people, discharge an estimated 0.578 mgd into the groundwater, which eventually reaches the coastal waters.

#### 1.6.1.9 Koolaupoko Streams: Kawa, Kapaa, and Waimanalo

Three fresh waterbodies are listed as water quality limited segments: Kawa, Kapaa, and Waimanalo streams. All three streams are within the Koolaupoko Watershed Region of Oahu. All three streams are listed as severely impaired in *Hawaii's Water Quality-Limited Waters: The 1997 Assessment* (DOH 1997, pp. 5-6). The severe impairment category is limited to waterbodies that have both extensive water quality criteria violations, as determined through site assessments, and reliable numeric water quality data supporting the observed violations. Severely impaired waterbodies are characterized by advanced degradation; their ability to support plant and animal communities or human recreation is in serious jeopardy.

**Kawa Stream** is located in the southern part of the Kaneohe Bay drainage system. Kawa Stream drains both conservation lands and urban /residential areas. In its urban section, it passes



by Hawaiian Memorial Park Cemetery, Castle High School, and Bay View Golf Course and discharges into Kaneohe Bay near the Waikalua Fishpond. The water quality of Kawa Stream exceeds levels for turbidity, nitrate, nitrite/nitrogen, total nitrogen, and total phosphorous. Nutrient management of large land users and residential community is the potential source of impairment. Channelization in portions of this stream contributes to impairment (DOH 1997, Appendix F).

**Kapaa Stream** is located mauka of Kawainui Marsh and discharges into the marsh. Kapaa Stream drains a small watershed which includes a rock quarry (Kapaa Quarry) and a closed county landfill which contributes large amounts of nitrogen, phosphorous, and sediments to the stream (DOH 1997, p. 6). The land uses in the area are urban and conservation. Water quality monitoring data show exceedances of the water quality criteria for nitrogen and phosphorous. Visual assessments have cited large amounts of floating algae, water hyacinth, and oil film. A significant amount of litter has been found in the stream and the surrounding area. In its lower portion the channel has been straightened and cleared (DOH 1997, Appendix F).

**Waimanalo Stream** is located in the southeast portion of the Koolau-poko Watershed Region. Waimanalo Stream receives runoff from conservation land, agriculture, roads and highways, a golf course, and lands used by the military (Bellows Air Field Station). It discharges into Waimanalo Bay, just north of Bellows Field Beach Park. Livestock raised nearby is one possible source of pollution. Algal blooms have been noted near the bridge where the Kalanianaʻole Highway crosses. Portions of the stream have been channelized and cleared of vegetation. There is evidence of stream bank erosion and the stream is turbid during strong flows. This waterbody consistently exceeds water quality standards for total nitrogen, nitrate, and nitrite (DOH 1997, Appendix F)

### 1.6.2 Maui County:

The following descriptions of the Water Quality Limited Segments in Maui County are based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii's Coastal Nonpoint Pollution Control Program Management Plan* (1996), *Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems* (Department of Health 1990), supplemented by information from the *Water Quality Management Plan for the County of Maui* prepared jointly by Department of Health and the County of Maui (Department of Health 1993). There are three Water Quality Limited Segments in Maui County: two on the island of Maui and one on Molokai. (See Appendix F for additional details.) The following description covers the three Water Quality Limited Segments and their watersheds.

#### 1.6.2.1 Kahului Bay

Kahului Bay is located on the north coast of the Island of Maui between the slopes of two volcanoes, Haleakala, and West Maui. It covers an area of 242 acres and is bounded by the breakwaters which extend from the west and east shores at about right angles to each other. Kahului Harbor is located on the southern portion of the Bay.

Drainage into Kahului Bay is largely runoff from the urban centers of Wailuku and Kahului. In addition, ship and barge traffic, the Kahului airport, lands used for sugarcane cultivation, and the eastern portions of the West Maui mountains (forested land) contribute pollutants. No streams or springs enter Kahului Bay.

State monitoring of Kahului Bay indicates that water quality standards for nitrogen, phosphorus, and turbidity are regularly exceeded. Incidents of bacterial contamination which result from cruise ship spills and storm drain outputs have been reported. The waters of the bay are generally poor in quality. The powerful long shore current, which sweeps around the north tip of East Maui, likely affects the residence time of pollution in Kahului Bay. Waters at the mouth of the harbor are generally turbid, and underwater visibility is generally poor due to strong winds that keep waters turbulent and murky (DOH 1990a, p. V-8).

Kahului Harbor is the main port of the Island with an estimated 98.9% of all goods coming into Maui transported through the harbor. Harbor activities include ship operation and maintenance, oil handling and bunkering, warehousing, trucking, storage, stevedoring, marine repair, and limited dry-docking (DOH 1990a, p. V-9). In addition, a cluster of hotels, beaches, the Kahului Breakwater Park, and a public boat ramp border the Bay. Shoreline access to the bay is excellent. People fish along the piers, breakwaters, and the coast between the harbor and Nehe Point. Large surf breaks in the harbor during periods of North Pacific swells.

### 1.6.2.2 West Maui

The West Maui area was designated as a Water Quality Limited Segment in 1992 primarily because of the algal blooms that have been occurring there and which are suspected to be caused by excessive nutrients from runoff. The nearshore coastal waters of Kihei are also included in this designation. Violations in this area are all for nitrogen parameters: total Kjeldahl nitrogen, nitrate-nitrite N, and ammonia nitrogen. Federal funds obtained by EPA and NOAA are being used to support a watershed coordinator; additional applied research projects have been conducted on the link between land use activities and surface and ground water quality. Department of Health intends to incorporate the results from these projects into nutrient/sediment watershed management plans for West Maui and similar sensitive coastal areas throughout the State (DOH 1993c, p. VII-14). This information will also be used by EPA and the Department of Health to establish Total Maximum Daily Loads (TMDLs) for this Water Quality Limited Segment.

### 1.6.2.3 South Molokai

The South Molokai segment is bounded by the 18-foot depth contour from Laau Point eastward to Honouliwai, just east of Waialua. Many streams within this area, mostly the eastern portion, are perennial in their upper reaches and intermittent or nonexistent at the coastline. During heavy rains, however, these streams will fill with water, overflow their banks, and flood the entire southern coastline with turbid runoff. Runoff transported by these streams is generated from abandoned pineapple fields, cropland, pastures, a State highway system, a network of dirt roads, feral animal activity, damaged areas from range fires and the town of Kaunakakai. The dirt roads, fire-damaged areas, and poorly managed pastureland are of particular concern.

On Molokai, drought conditions and incessant strong winds reduce soil moisture, preventing the growth of adequate cover. When rains do occur, they are often intense and heavy, creating immense amounts of runoff that can transport sediments and pollutants. Flows into South Molokai are heaviest into the Palaa coastal plains located just west of Kaunakakai (DOH 1990a, p. V-15).

The waters of South Molokai are classified as open coastal waters. State monitoring of South Molokai shows significant violations of water quality standards for suspended solids and nutrients. Suspended solids have been noted to exceed the standard by 100 times.

Mudflats predominate on the south coast of the Island where there once were a large number of fishponds. Valued water activities along the southern coast include fishpond restoration for commercial and subsistence use; support of an important wildlife area and enhancement of park facilities. Parks and recreational facilities on Molokai's south shore include: Kakahaia National Wildlife Refuge, One Alii Beach Parks 1 & 2, and Malama Park.

### 1.6.3 Kauai County:

The following descriptions of the Water Quality Limited Segments on Kauai County are based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii's Coastal Nonpoint Pollution Control Program Management Plan* (1996), *Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems* (Department of Health 1990), supplemented by information from the *Water Quality Management Plan for the County of Kauai* prepared jointly by the Department of Health and the County of Kauai (Department of Health 1993b). There are three Water Quality Limited Segments on Kauai. (See Appendix F for additional details.) A description of the segments and their drainage follows.

#### 1.6.3.1 Nawiliwili Harbor

Nawiliwili Harbor and its adjacent bay are located on the southeast coast of Kauai, two miles from Lihue. A well-developed embayment of 333 acres, it is formed by the confluence of three streams, Huleia, Puali, and Nawiliwili. Huleia is the largest stream, arising from the Waialeale-Kawaikini mountains in central Kauai and flowing through forest, agricultural, pasture, and other lands. The lower part of Huleia Stream widens into a significant estuary. Although the Nawiliwili and Puali streams drain flatter and less erosive lands, they also contribute nonpoint pollutants. A rock quarry located on the Nawiliwili Stream is a major contributor of sediment to the bay (DOH 1993b, p. V-12).

Although there are no longer any point source discharges into Nawiliwili Bay, State monitoring shows that water quality standards for nitrogen and turbidity are regularly exceeded. These levels are suspected to be the product of vegetative growth decomposing along the streams as well as seasonal input from storm water sources, which transports silt and nutrients from sugarcane land into the bay and give it a brown color at times. (DOH 1993b, p. V-13)

Nawiliwili Harbor supports a deep-draft commercial harbor and a small boat harbor with charter fishing operations. Periodic dredging is required to maintain navigable depths in the

harbor. Recreational activities include fishing and crabbing in the bay and adjoining Huleia River, and surfing and canoe paddling in the area fronting Kalapaki Beach on the north shore of the bay (DOH 1993b, p. V-14).

#### 1.6.3.2 Hanapepe Bay

Hanapepe Bay is located on the southwest corner of Kauai, between Hanapepe and Port Allen. The boundary of the Hanapepe Bay segment encloses 297 acres of water surface (DOH 1993b, p. V-3).

The Hanapepe River travels from forested uplands through pasture and range land, coffee lands, sugar cane lands, and the small towns of 'Eleele, Port Allen, and Hanapepe. Hydrologic modifications have greatly affected the bay. Erosion of the western end of the one-half-mile-long beach at the head of the bay has been accelerated because of construction of a breakwater (DOH 1993b, p. V-3).

State water monitoring records indicate that the waters of the bay regularly exceed State standards for turbidity. Discoloration of the bay because of flood flow discharges is a common occurrence. However, the waters generally clear rapidly.

An important Native Hawaiian salt production area and salt marshes with great wildlife value are located on the east banks of the bay. Some commercial activity occurs in Hanapepe Bay at Port Allen but for the most part, activity in the bay is recreational. Activities include swimming, pole and line fishing, and small boating (DOH 1993b, p. V-4).

#### 1.6.3.3 Waimea Bay

The Waimea Bay Water Quality Limited Segment is located on the southwest coast of Kauai. It comprises 1,214 acres and includes the Waimea River and Kiki a Ola Boat Harbor. Two rivers flow into the bay, Waimea and Makaweli.

The watershed has conservation lands at its headwaters and agriculture land use is dominant below. Currently, crops are grown for commercial seeding operations and agricultural research. Historically, sugar mills discharged cane trash and wastewater into the coastal waters of southern Kauai. These discharges contained silt that was carried by ocean currents to Waimea Bay. Bagasse (cane waste) is now used as a fuel source and the mill wastewater is returned to sugar cane fields for irrigation. The only remaining discharges are of irrigation tailwater (DOH 1993b, p. V-17). There are small urban runoff issues since the town of Waimea is located within this water quality limited segment. Sediment is the major water quality pollutant.

There is a boat-launching ramp at Kiki a Ola light draft vessel harbor. Uses of Waimea Bay include pole and line fishing, throw netting, board surfing, canoe paddling, limu gathering, gill netting, and torchlight fishing (DOH 1993b, p. V-18).

#### 1.6.4 *Hawaii County:*

The following description of the Water Quality Limited Segment in Hawaii County is based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii's Coastal Nonpoint Pollution Control Program Management Plan* (1996), *Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems* (Department of Health 1990), supplemented by information from the *Water Quality Management Plan for the County of Hawaii* prepared jointly by the Hawaii State Department of Health and the County of Hawaii (Department of Health 1993a). (See Appendix F for additional details.) Hilo Bay is the only Water Quality Limited Segment on Hawaii Island.

##### 1.6.4.1 Hilo Bay

Hilo Bay is located on the northeast coast of the Island of Hawaii. It covers an area of 1,788 acres and includes Waiakea Pond and Wailoa River (DOH 1990a, p. V-4).

Five natural discharges enter the Hilo Bay segment: Wailoa River, Wailuku River, Pukihae Stream, Pohakaunanaka (intermittent stream), and Maili Stream. These rivers and their tributaries originate on the slopes of Mauna Kea and Mauna Loa, and drain forests, pasture and range land, agricultural fields, and urban areas. Cattle graze the Puu Oo area above the forest reserve and the mauka fringe of the city of Hilo. Sugar, which was formerly the principal crop of the island, was grown in the rural areas north of Hilo along the Belt Highway. Major agricultural changes have occurred in recent times with the closures of sugar plantations. An example is the conversion of 8,000 acres of sugar cane land to macadamia nut orchard. Commercial raising of trees, mostly eucalyptus, is expanding in this area. Specialty crops such as ginger are grown nearby also. Cattle, hogs, poultry, vegetables, flowers, and landscaping plants are also grown in the area surrounding Hilo. Urban runoff come from such sources as stream channelization, Hilo's parks, business and residential zones, infrastructure, and harbor.

The Wailuku (300 mgd) and Wailoa rivers (100 mgd to 300 mgd), compose the major discharges of water and sediment to the bay. Large surface and subsurface flows enter the bay and form a fresh water layer on the surface of the bay. The vertical stratification, which is maintained by the prevailing shoreward trade winds of the area, prolongs the residence time of water in the bay and encourages the growth of phytoplankton in its upper fresh water layer. In addition, the slow seaward movement of the lower waters of the bay is generally insufficient to flush out suspended silts from the bay. Silt and mud that accumulate contribute to the turbidity of the Bay (DOH 1990a, p. V-5).

Nutrient-rich waters, which enter as both surface and subsurface flows, increase the growth of microscopic life and algae contributing to the turbidity of the bay. Nutrient-rich flows include the surface flows of the Wailoa River as well as subsurface flows from sources near Reeds Bay, Coconut Island, and the Keaukaha area. Subsurface flows contribute flow volumes as high as 200 mgd.

State monitoring of water for Hilo Bay shows frequent violations of water quality standards for nitrogen, phosphorus, and turbidity. A study found exceptionally high levels of

arsenic in sediments in Hilo Bay and, in particular, from Waiakea Pond. These high arsenic levels resulted from waste discharges containing arsenic trioxide, a compound used in a former kenec manufacturing facility to treat fiber boards to prevent termite damage. Other contaminants found in Hilo Bay included lead, zinc, chromium, chlordane residues, and polychlorinated biphenols (PCBs). Despite these high levels, however, there is no indication of any health hazard.

Hilo Bay is also affected by seepage from cesspools. A study confirmed Department of Health monitoring results and notes that Hilo Bay, its estuaries, and adjacent marine waters are subject to chronic nonpoint source sewage pollution. The data in the study report indicate that high bacterial counts are not the result of sewage treatment plant failures but rather sewage contained in freshwater runoff, with the ultimate source commercial and residential cesspools.

In spite of its water quality problems, Hilo Bay is an important wildlife and fishery area. In addition, Hilo Bay is highly visible to residents and tourists and supports a fair amount of recreational boating.

### **1.7 Other UWA priority watersheds that do not contain a Water Quality Limited Segment**

The previously mentioned water bodies and their associated watersheds all contain a Water Quality Limited Segment. Such a designation means that the waterbody exceeds State water quality standards on a regular basis due to polluted runoff. This designation is one criterion for a waterbody to be listed as a Category I watershed in Hawaii's Unified Watershed Assessment (UWA) Plan (1998).

However, there are two other watersheds listed in the Hawaii UWA Plan as Category I watersheds due to criteria such as significant cultural resources, habitat restoration, and minor water quality diminishment. The following is a description of these watersheds and their associated environmental issues.

#### *1.7.1 Kahoolawe Island<sup>1</sup>*

The coastal waters that surround and their associated watersheds for the Island of Kahoolawe have been designated as a Category I watershed in the Hawaii Unified Watershed Assessment Plan. It is not listed as a WQLS as are most of the other watersheds listed in that plan. Kahoolawe is listed because reasons of cultural significance and habitat destruction.

The Kahoolawe Island Reserve Commission (KIRC) manages the Reserve on behalf of the State and utilizes a Native Hawaiian approach to resource management and restoration. The KIRC has adopted a vision statement where, "The kīno (physical manifestation) of Kanaloa is restored. Forests and shrublands of native plants and other biota clothe its slopes and valleys. Pristine ocean waters and healthy reef ecosystems are the foundation that supports and surround the island...". The Hawaiian concept of *aina* recognizes the inter-relationships of land and

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<sup>1</sup> The information contained in this section was provided by the Kahoolawe Island Reserve Commission.

ocean; appropriately and necessarily then, preservation and restoration of marine habitats will in no small measure depend on the effectiveness of the terrestrial revegetation efforts.

On Kahoolawe, over 50 watersheds have been grouped into eight land divisions (ili) consistent with the Native Hawaiian practices. Each ili is characterized by an eroded upland which consists of exposed, unfertile hardpan and severe gullying, drainage basins lined with predominantly alien dry land vegetation, and ephemeral streams which discharge sediment laden water into a variety of marine environments, including coral reef ecosystems.

In fulfilling its responsibilities, the KIRC is confronted by numerous environmental, logistical, and financial challenges. The severely eroded uplands, which resulted from 200 years of feral ungulate grazing, now cover approximately one-third of the island. An estimated 1.9 million tons of soil continues to be lost each year as a result of wind and water erosion. Only 25 inches of rain falls at the summit, with perhaps less than 10 inches per year at the coast. Most plants on Kahoolawe are hardy alien species (i.e., kiawe, bufflegrass, and koa haole) with a few small native plant populations. In addition, unexploded ordnance from 50 years of military use and sensitive archaeological sites complicate environmental and marine restoration efforts.

An Environmental Restoration Plan and an Ocean Management Plan guide the KIRC in managing and restoring the Reserve. Both plans provide a merging of Native Hawaiian and western approaches to habitat and environmental restoration. Implementation of the plans rests with the KIRC's Restoration and Ocean Management staff who periodically conduct volunteer trips to Kahoolawe for planting native species and erosion control projects in areas cleared of UXO<sup>2</sup>. In addition, volunteer trips into the Reserve waters are conducted aboard the KIRC's research/monitoring vessel, *Hakilo*, for data collection and resource observation.

Progress to date has provided valuable insight and data for future restoration efforts. However, considerable program development and long term efforts will be necessary to reverse the course erosion and degradation and realize the KIRC's vision.

#### *1.7.2 Pelekane Bay (Kawaihae Watershed)*

Pelekane Bay is located just south of the Kawaihae State Boat Harbor, in the South Kohala District, on the island of Hawaii. The drainage area of Pelekane Bay makes up nearly half of the Kawaihae Watershed. The Kohala Mountains are at top of the watershed, which passes down near Waiaka, basically paralleling State Highway 19, the Kawaihae Road, to the ocean; on its north side it parallels the Makahuna Gulch drainage from the harbor up past Kawaihae Uka to the top of the mountains. It has an elevation range from 1,600 feet to sea level. It has a varied rainfall regime that is only 5-6 inches annually at the Kawaihae Harbor to 150 inches annually at its summit. It is not a heavily populated watershed with most of the population being in Kawaihae Village. There is one large poultry producer. Much of the land is used for range cattle, mostly under management of Parker Ranch.

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2 UXO stands for "unexploded ordnance"; it is also the name of a contractor that is clearing the ordnance.

Pelekane Bay has been listed as a Category I watershed less for water quality issues and more for significant cultural and habitat resource issues. There has been water quality degradation but not to the extent that the water body of Pelekane Bay is listed as a WQLS. However silt built up in the bay and apparent changes in fish and other life in the bay have been observed. Much of the silt is from past practices of overgrazing lands and vegetation destruction due to range fires.

Pelekane Bay includes Puukohola Heiau that is managed by the National Park Service. In addition to this cultural resource, there are ancient rock walls, house platforms, and agriculture mounds found throughout the watershed. There is evidence that a submerged shark heiau exists buried under sediment in the bay. Controlling the pollution load into the bay and dredging out the bay will aid in restoring this cultural resource. This will also improve the habitat of the Bay for fishery.

The need for restoration of native habitats is another reason Pelekane Bay has been listed as a Category I watershed. Native vegetation has been lost because of fires and range cattle. The Mauna Kea Soil and Water Conservation District has put together a coordinated resource management plan for Pelekane Bay that identifies many of the issues that need to be addressed, as well as some of the projects that could be implemented to allow this watershed to be reclassified as a healthy one.